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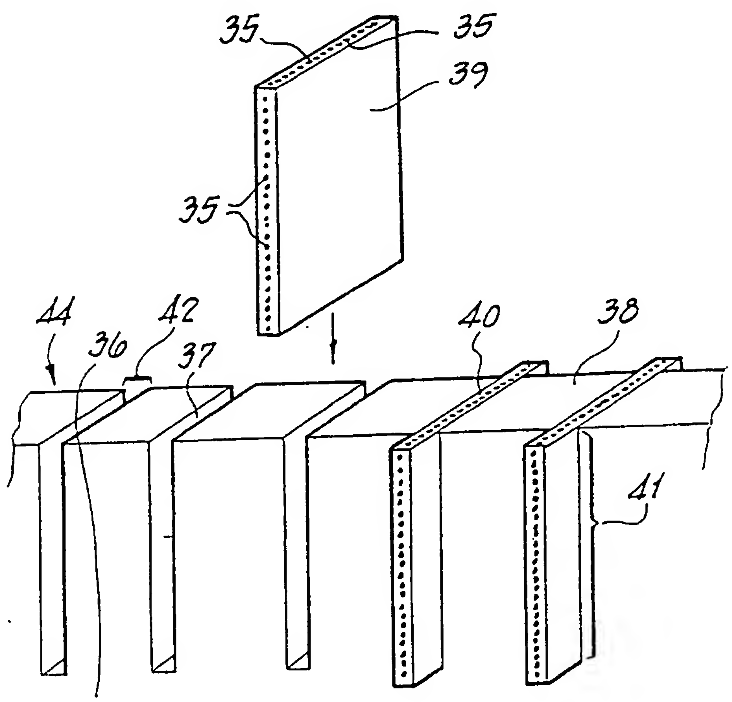

(57) Abstract

Abrasive tools made by co-depositing a layer of metal from a solution of that metal together with abrasive grains e.g. diamond, to form an element of a tool, which element is mounted on the body of a tool so that the layer is presented endwise to the face to be cut so as to provide abrasive grains to any reasonable required depth at the working surface, and to provide a means of controlling grain concentration.

Abrasive tool and a method of making said tool.

The present invention relates to tools and tool elements of the kind incorporating a plurality of grains embedded in a body which is large relative to the grains. Examples of such tools include grinding wheels, saw blades, hones, laps, reamers, files, drills and others using as the grains, such materials as diamond, cubic boron nitride, silicon carbide, tungsten carbide, aluminium oxide etc.

It is known to provide on a metal body of a tool, a surface layer of an electro-deposited metal in which are embedded abrasive grains, such as diamond, cubic boron nitride et al. It is further known that a second, third or more layers of grain can be deposited on top of each preceding layer, each being successively embedded in electro-deposited metal. The number of such layers which can be laid down the one on the other, is however, very limited, as discussed below.

The method described above, of making tools, has an advantage over those other common methods in which grains are embedded in metal powders subsequently heated and pressed, in that the grains are more securely held in a metal produced by electro-deposition, than in a metal powder compact. Possibly this is because the electro-deposited metal, being deposited atom by atom, is in more intimate contact with the grains, or maybe it is due to the internal stresses inherent in the electro-deposit. It is in practice very difficult to dislodge grains from electro-deposited metal, even if the layer of metal is only a small fraction of the diameter of the grains in thickness.

However, this method also has characteristics which are disadvantageous in some circumstances. The grains so provided on the surface form a contiguous layer, each grain being virtually in contact with each of its neighbours, and it is difficult to provide a means of separating grain from grain in a controlled and even manner. Thus the

concentration of grains at the surface, ie the number of grains per unit area, is dependent only on the size of those grains, and cannot easily be reduced. It could be advantageous to reduce this number when machining glass for example.

It is also difficult to build up the number of layers of grain because the electro-plating process proceeds in such a manner that the surface becomes progressively more rough and uneven, in particular the edges or extremities of the electro-plated area are built up more than the area between. In practice it is possible to build up many layers of grain whose diameter is of the order of 50 microns, but only one layer can normally be co-deposited if the grains are of the order of one millimetre in diameter.

An aim of the embodiments is to provide a method and products utilising the electro-plating process, to take advantage of the benefits, and eliminate or mitigate one or more of the drawbacks of that process, and/or to provide improvements generally.

According to one aspect of the present invention there is provided a method of making a tool as defined in the accompanying claims. In a preferred embodiment, such a tool is provided of the type incorporating a plurality of grains embedded in a body which is large compared with the grains. A plurality of grains are embedded in metal deposited from a solution of that metal by electro- or chemical deposition, such grains and metal constituting each with the other a component smaller than the body but large compared with the grains. One or more such components are positioned and held on or in the body of the tool in such manner that there is presented at any working surface of the tool at any time during the working life of the tool, a number of such grains approximating closely to that number of such grains deemed desirable, and also being presented in such a manner that as those grains first presented at the working face are removed by attrition of

the working face of the tool, those further grains underlying the initial working face of the tool are successively exposed at the working face of the tool. The depth to which those successive grains are provided, measured in a direction normal to the principal working face of the tool, being limited only by the physical characteristics of the tool, and not by the limitations imposed by the deposition process.

The broadest aspect of the invention is not necessarily limited by all features of any one particular claim hereof. The invention also provides tools and tool elements per se.

The word 'composite' as used herein means a grain bearing component, made by depositing metal from a solution of that metal, onto a former or mould of the desired shape, such deposited metal containing embedded within it a plurality of grains of material different from that of the metal, such deposited metal being separated from or adherently attached to the former or mould on which it was deposited, and such component being small compared with the body of the tool, but large compared with the grains.

Any tool made according to the method disclosed herein, may comprise a body, usually made of metal, and one or more composites as heretofore defined.

An example of a composite made on a former to which the nickel is adherent would be a steel cylinder, coated adherently on its curvilinear surface with nickel in which is embedded a plurality of grains of diamond. An example of a composite made on a former or mould from which it is subsequently separated would be a sheet of nickel in which grains of diamond are embedded, which sheet of nickel being produced by electro-deposition onto aluminium, from which aluminium the deposit is removed after completion of the deposition process.

Examples of both these techniques are included herein.

Embodiments of the invention will now be described by

way of example with reference to the accompanying drawings in which:-

Fig 1 shows a cylindrical composite made on a former to which the nickel deposit is adherent;

Fig 2 shows a flat composite, made on an aluminium former from which it is detached, and also part of that former;

Fig 3 shows a representative part of a body of a tool, together with cylindrical composites, both inserted into, and about to be inserted into holes drilled into that body;

Fig 4 shows a section in the plane IV -IV in Fig 3;

Fig 5 shows a top view of a cylindrical composite let into a body, to illustrate the appearance of the ring of grains at the working surface, and Fig 5A shows a cross-section of that cylindrical surface after grinding or lapping;

Fig 6 shows a perspective view, illustrating the method of insertion of composites into a hack-saw blade; and

Figs 7 to 10 show further examples of composites, Figs 7 and 8 showing composites detached from the formers on which the metal is deposited, and Figs 9 and 10 showing composites in which deposited metal is adherently attached to the former on which metal is deposited.

When nickel is electro-plated onto a surface, it is possible to incorporate grains of non-electrically conductive material into such electro-deposited nickel, by sprinkling the surface being electro-plated with such grains while plating proceeds. If deposition of nickel is continued for long enough, the nickel will build up between and around the grains, if continued further the metal will eventually grow over the grains completely burying them. This is the basic process by which electro-plated abrasive tools are made. The grain employed may be diamond or cubic boron nitride.

A layer of diamond or cubic boron nitride grains is

provided over the whole or part of the surface of the tool required to function as the abrasive surface. The grains are not completely buried in the nickel but left exposed on the surface, in a similar manner to that in which the grains on a sheet of sandpaper are left exposed.

There follows a description of a modified method of making two basic types of composite or abrasive tool element for incorporation into abrasive tools, and their method of use, according to the invention.

To manufacture a cylindrical composite 10 exemplifying the type in which the deposited metal is adherently deposited on the former on which it is made, as shown in Fig 1, a solid metal cylinder 15 is provided, which cylinder is small compared with the body 18 of the tool to which it is ultimately to be fixed. Such cylinder is provided on its curvilinear surface, by the method briefly described above, with a coating or layer of nickel 16 in which is embedded one or more contiguous layers of diamond grains 17. The ends of the cylinder are not so provided with nickel or diamond grains. It is advantageous to the strength of the composite so made, and to the grit retention characteristics of the composite, that the diamond grains are completely buried by the nickel deposit, but it is not essential to the method of the invention that all or indeed any of the grains should be completely buried, provided that sufficient nickel has been built up around the grains to hold the grains securely.

The preferred metal of which such cylinders are made is steel. The length of such cylinder, measured along its cylindrical axis is preferably one to five times the diameter of such cylinder though no restriction is placed on this ratio by the method of the invention.

In order to make a useful tool by the method of the invention, a number of such composites or cylinders, coated in the manner described may be provided. The number of such coated cylinders or composites used will be determined

by such factors as the length and diameter of the coated cylinders, the weight of diamond embedded in each such cylinder, and the total weight of diamond required in the completed tool. The length and diameter of such cylinders will also be controlled by factors such as the size of grains of diamond desired, the area and shape of the working surface of the tool being manufactured, the depth to which it is desired to provide diamond grains, measured from the working face etc. Each of these factors may be inter-dependent, but the choice of which does not affect the method of the invention.

As shown in Figs 3 to 5 the body 18 needed to make the particular tool required, being provided, is drilled with a number of holes 19, such holes being drilled into the intended working or cutting face 20 of the body in a direction normal to said face so that the grains in the composite or tool element are progressively exposed lengthwise or axially of the abrasive layer of the composite. The number of such holes is equal to the number of composites 10 it is intended to provide in the tool, the diameter of such holes being the same as or slightly greater than the diameter of the cylindrical composites it is intended to use, the depth of such holes being the same as the length of the cylindrical composites it is intended to use, and the position and distribution of such holes over the intended working surface being governed by the position at which it is intended to provide the diamond grains. One composite is inserted into each hole, pressed into such hole until the axially outer end of such composite lies at the surface of the body, and fastened into that position by the chosen method. In this example the preferred method of fastening is to use silver solder, but any other suitable method such as brazing, welding glueing, screwing, bolting, clamping, pressing etc could be used as an alternative.

The working surface of such tool, including the

embedded cylindrical composites, may now be machined by any method considered suitable, ie by grinding or lapping with loose abrasive et al, so that such working surface is rendered flat and level, and the grains of diamond embedded at the outer end of each cylindrical composite are exposed and protrude slightly above the body of the tool in the form of a ring of diamonds 17. Such exposed diamonds provide the cutting element of the tool. When the tool is put into use, those grains initially exposed at the working surface, will gradually be worn away, and/or pulled from the surrounding matrix of nickel in which they are embedded. At the same time, both the nickel matrix and the steel comprising the body adjacent to the nickel will be abraded by the workpiece, so allowing new grains 26 to be exposed at the working face of the tool. This process of continual removal of worn grains, nickel matrix, and body material will continue until all the diamond grains have been consumed, when the tool will no longer be capable of cutting the workpiece. The depth to which such grains of diamond are provided in the tool being the same as the initial axial length of the cylindrical composites soldered in the body, instead of merely the radial depth of the coating on the cylinder.

The method described above is not limited to the use of cylindrical composites, which is described by way of example only. Composites may be made by similar deposition techniques on metallic or non-metallic elements of any suitable size and/or shape. For example, brass, aluminium, copper, bronze, nylon, polypropylene, polyvinyl chloride, glass, ceramic and virtually any other material may be used from which to manufacture the former on which the deposited nickel is formed. The shape of the former is not confined to a cylinder. The former may be a rod of any cross-section, a flat, curved or bent plate, a tube of any cross-section coated on the inner or outer or both surfaces, or any other shape capable of being mounted on or in the body

of the tool so that the advantages of the invention are obtained.

In a second embodiment of the invention the nickel/grain composite is detached from the mould or former before being mounted and affixed in or on the body of the tool. A method of manufacture exemplifying such a composite and a method of employing it according to the method of the invention now follows.

As shown in Fig 2, a flat plate 28 or former made of aluminium of a convenient size and shape, (150 mm x 150 mm x 10 mm would be suitable for a small number of composites of this type) is cleaned, degreased and prepared for plating on one large face, all other faces being masked in any convenient manner. This exposed face need not be treated in any manner designed to increase the adhesion between the aluminium and the nickel subsequently deposited on the aluminium.

The aluminium plate being made ready, electro-plating is commenced in a suitable nickel plating solution, and a layer of nickel 29 at least equal and preferably greater in thickness than the diameter of the grains subsequently to be embedded in the nickel, is deposited. The grains 30 are then introduced into the bath while deposition continues, and one or more layers of grain as required are incorporated into the nickel electro-deposit. Deposition is further continued until all required grains have been completely embedded in the nickel and the topmost grains are completely buried under a layer 31 of nickel equal to or greater than the diameter of the grains so embedded. It will be appreciated that the thickness of the nickel layer produced both before introduction of the grains and after the grains have been incorporated, while being of relevance in determining the strength of each individual composite, is not of itself of particular importance to the method of the invention.

Deposition having been completed, the plate with its

deposit is removed from the bath, and the nickel layer, complete with its embedded grains may be peeled from the aluminium plate as indicated by the separation shown in Fig 2. Such a sheet of nickel with grain embedded in it may be cut into suitable sized pieces for incorporation into any required tool in the manner according to the invention. The aluminium plate could have been masked on the surface to be plated, by use of a suitable resist, so that small individual composite pieces were produced, which did not need cutting into smaller pieces, it being perfectly possible to produce in this manner individual composites of the size required for incorporation into the body of the tool required.

The method of the invention as applied to the use of such detachable composites, to manufacture for example a hack-saw blade, is now described. Fig 6 shows a section or part of such blade body with slots and composites, and method of insertion.

Composites are prepared as heretofore described, each composite being 1.5 mm in thickness, 10 mm in length and 3 mm in width, containing embedded within them a contiguous layer of diamond grains 35. A body 36 for such tool is provided, being made of high speed steel, or a similar material, such body being 500 mm in length, 50 mm in depth and 2 mm in thickness. The body is then provided with a plurality of slots 37 cut into one edge 38 of the body, such slots being 10 mm in depth 41, measured from the edge 38, and being 1.5 mm in width 42. One composite 39 is inserted into each slot in such a manner that it completely fills the slot, protruding 0.5 mm from each side of the body, with the outward end 40 of each composite being level with the edge 38 of the body. In this position each composite is fastened so that the grains in the composite or tool element are progressively exposed lengthwise of the abrasive layer (as opposed to depthwise). In this example the preferred method of fastening would be by the use of

silver solder, but the composites could alternatively be fastened by glueing, welding, brazing, clamping or any other method of holding them securely in the desired position. The cutting edge 44 containing the composites may now be lapped, ground or otherwise treated in order to expose the grains of diamond at that edge, each composite displaying a layer of diamond grains disposed across the working edge of the blade.

Composites made by the deposition of metal onto a mould or former from which they are subsequently detached, do not necessarily have to be in the form or shape of flat sheets. Such composites may be made to provide any cross-section at the working face of the tool. For example, tubes of nickel containing the abrasive grains can be manufactured by similar techniques, such tubes would provide grains at the working surface in the form of a ring or ellipse if the tube were round in cross-section, a square or rectangle if the tube were square in cross-section. An ideal shape for the composites used to manufacture the above-described hack-saw blade, or circular saw blades, or drills would be in the generally U-section form shown in Fig 7. Fig 8 shows an arcuate section composite, Fig 9 shows a flat composite having two layers of grains embedded in brass and Fig 10 shows a rectangular composite having a glass central portion. No limitation is intended to be imposed on the method of the invention, by the shape of the cross-section of any composite employed. Composites do not need to be fitted directly to the main body of any tool as described heretofore. They may be fitted on or in a subsidiary body, which subsidiary body may then form a fixed or removable part of any such tool. The term 'body' as used herein therefore always includes such subsidiary components. Composites may be affixed to the body of any tool by any suitable and practical means, for example, they may be welded, brazed, soldered, clamped, screwed, bolted, pressed or otherwise held, either

individually or in clusters by fastening a number together before fastening such cluster to the body.

Composites may be fastened to the surface of any body, or let into holes or slots formed in the body. If affixed to the surface of the body, they may be left standing proud of such body to provide free circulation of air or coolant around each composite or group of composites, or after fixing in such a manner they may be surrounded by resin, metal, glass, ceramic or any other material capable of being produced around them. Individual composites may extend across the whole or part of the principal working face of any tool, and composites of different type, the one from the other, may be combined within any one tool.

The composite affixed to the body of a tool may be so positioned that from each such composite is exposed at the principal working face of the tool, throughout the working life of such composite, a line or lines of grains, which line or lines are narrow compared with their length. Such lines of grains may be 'closed' ie the ends of such lines may meet to describe closed loops, for example 'rings', or alternatively such lines may be 'open' in which case they may be straight, curved, regular or irregular.

The above condition being met, the depth to which grains are provided measured in a direction normal to the working surface of the tool under consideration, is dependent upon the length of the composites provided in that particular tool. In practice this means that the length of such composite measured from that end destined to become the working face of the composite, is the same as the depth to which grains are provided in the tool, measured in a direction normal to the principal working face of the tool, each composite being set normal to such working face. However, composites do not need to be set normal to the principal working face of the tool to comply with the method of the invention. Composites may be set on or in the body of the tool at any angle to the working face

of such tool, providing that from each such composite there is capable of being exposed at the principal working face of such a tool, grains for example in the form of a line or lines, either open or closed as heretofore described, embedded in each such composite.

The metal in which the grains are directly embedded, being produced as described by electro-deposition, whilst being preferably composed of nickel produced from an electro-plating bath, may also be composed of any metal or metal alloy capable of being produced from a solution of that metal or alloy, by electro- or chemical deposition. Such metals include cobalt, copper, chromium, iron, lead, silver, zinc or others.

Due to the difficulty experienced with most metals other than nickel, it will usually be found necessary to deposit at least an initial thin layer of nickel to entrap and initially hold the grain, before building up the bulk of the deposited metal with any other desired metal. The major benefit that the use of metals other than nickel to directly encapsulate the grains will give, is to provide a means of optimising the hardness and wear characteristics of the finished tool, combined with the cutting power and cutting speed of such tools.

The body of any tool may be of any engineering material deemed suitable for the particular tool required. For example, the body of a hack-saw blade, circular saw blade or frame saw blade may be best made from a high speed steel. A suitable body for a peripheral grinding wheel type IAI, to be used to grind glass, may be composed of brass or a resin compound.

No restriction of the method of the invention is imposed by the use of any particular body material as described herein.

The choice of material for the construction of any tool body described herein is for the sake of example only.

Interestingly, the above embodiments of the invention

provide the advantage that by use of tool elements comprising one or more layers of electro- or chemically deposited material containing abrasive grains or the like, abrasive or cutting tools or the like can be manufactured having any reasonable depth of abrasive material according to requirements. The advantage of electro- or chemical deposition, well known and cost effective techniques, are retained while achieving the advantages of sintered metal structures or the like containing abrasive grains, but without the attendant costs of the latter. In short the limitation of electro- or chemical deposition to the production of thin layers of abrasive at the working surface of the tool is overcome, while the cost and other advantages are retained. By using a deposited abrasive layer in an endwise or axial fashion or attitude, instead of in a flat face or radial face manner, the invention enables a tool to have an abrasive layer containing fresh cutting grains for exposure, the layer being many times deeper in the wearing direction than the thickness of the deposited abrasive layer. The grains are progressively exposed lengthwise of the layer during use of the tool.

If an alternative depositable binding medium for the abrasive grains becomes available as an alternative to the metals mentioned above, this would be suitable for the purpose of the invention.

CLAIMS

1 A method of making a tool comprising co-depositing grains and a binding medium therefor in a layer to form a tool element, characterised by the step of mounting such element or a plurality of such elements on or in a tool body in such manner that said grains are progressively exposed lengthwise of said layer during use of the tool.

2 A method according to claim 1 characterised in that said binding medium is a metal and the tool element is mounted in such manner that there is provided at the working surface of said tool, a line or lines of said grains.

3 A method according to claim 1 or claim 2 characterised in that said grains are provided as a single contiguous layer.

4 A method according to claim 1 or claim 2 characterised in that said grains are provided in two or more layers.

5 A method according to claim 2, or claims 3 or 4 when dependent on claim 2, characterised in that said metal is deposited as elementary particles.

6 A method according to claim 2, or claim 3 or claim 4 when dependent on claim 2, characterised in that the deposited metal is deposited from a solution containing ions of that metal.

7 A method according to claim 6 characterised in that said metal is deposited by electrolysis of a solution.

8 A method according to claim 7 characterised in that

said metal is deposited by electrolysis of a solution containing said metal ions.

9 A method according to any one of claims 2 to 4 characterised in that said metal is deposited by chemical reduction of a solution of a compound of that metal.

10 A method according to any one of the preceding claims characterised in that said binding medium is deposited on a former, and the former together with the tool element formed thereon is incorporated into said tool.

11 A method according to any one of claims 1 to 9 characterised in that said binding medium is deposited on a former and is removed therefrom prior to incorporation of the tool element into the tool.

12 A method according to any one of the preceding claims characterised in that said tool element is affixed to the surface of a body of the tool.

13 A method according to any one of claims 1 to 11 characterised in that said tool element is incorporated into the body of the tool.

14 A method according to any one of claims 1 to 11 characterised in that said tool element is affixed to the surface of a body of the tool and is not then surrounded by solid material.

15 A method according to any one of the preceding claims characterised in that said grains are adhered to the surface of a mould or former on which said binding medium is to be deposited, before deposition of said medium.

16 A tool comprising a tool element incorporating co-

deposited grains and a binding medium therfor forming a layer, said tool element being mounted on or in a tool body in such manner that said grains are progressively exposed lengthwise of said layer during use of the tool.

17 A tool according to claim 16 characterised in that said binding medium is a metal and the tool element is mounted in such manner that there is provided at the working surface of said tool, a line or lines of said grains.

18 A method according to claim 16 or claim 17 characterised in that said grains are provided as a single contiguous layer.

19 A tool according to claim 16 or claim 18 characterised in that said grains are provided in two or more layers.

20 A tool according to any one of claims 16 to 19 characterised in that said grain comprises abrasive grain.

21 A tool according to any one of claims 16 to 20 characterised in that said grain comprises a mixture of two or more types of grain, at least one of which is an abrasive grain.

22 A tool element for use in a method according to any one of claims 1 to 14.

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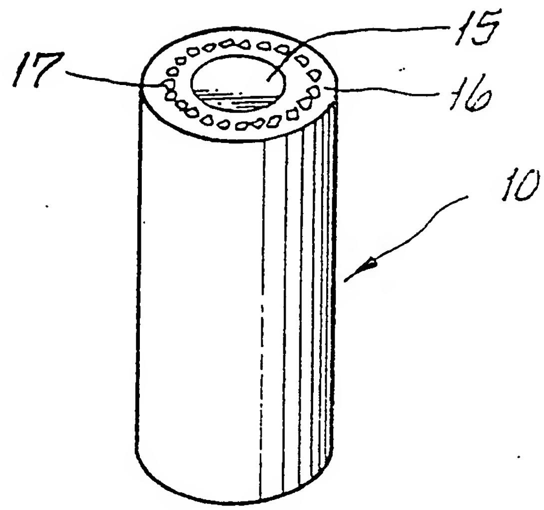

FIG.1

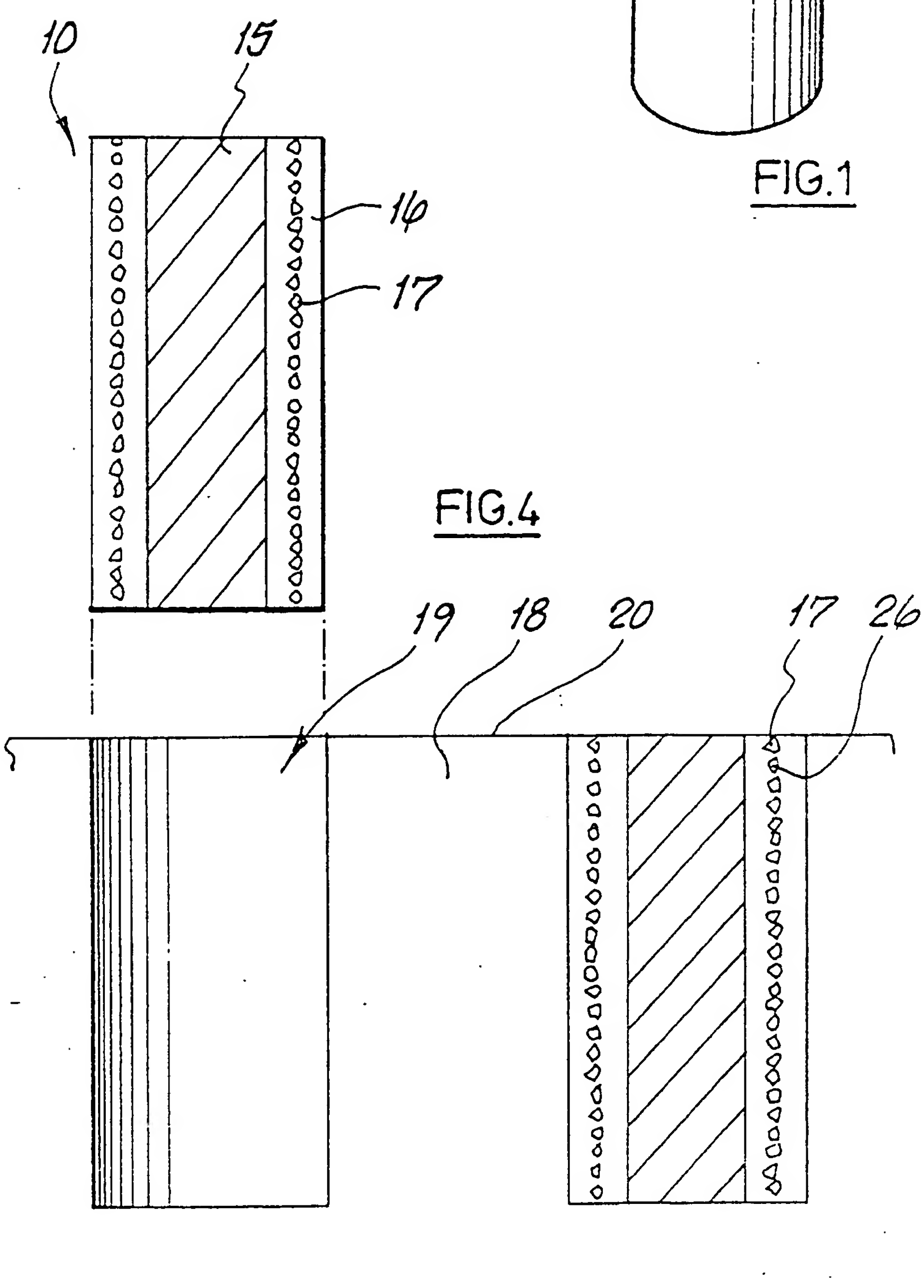

FIG.4

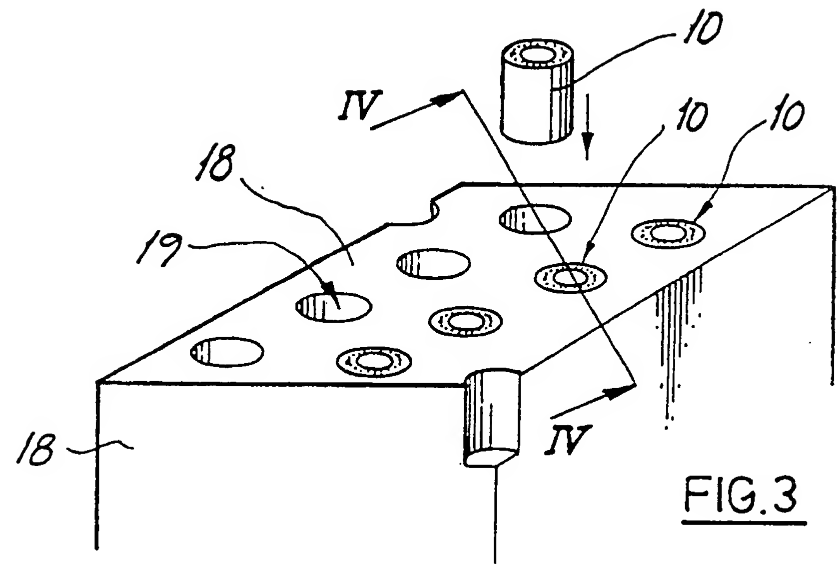

FIG.3

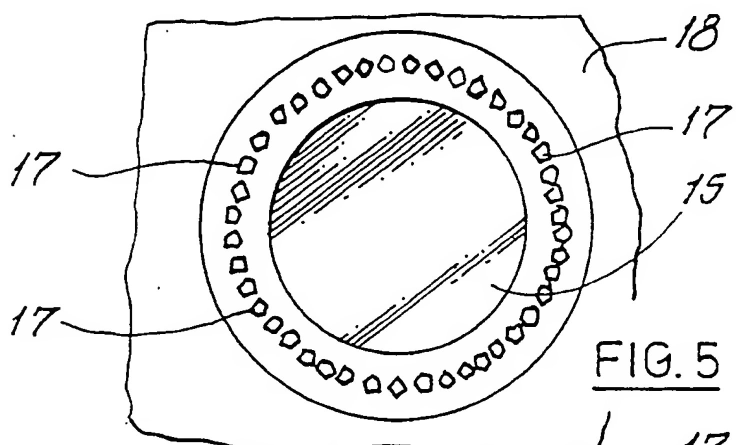

FIG. 5

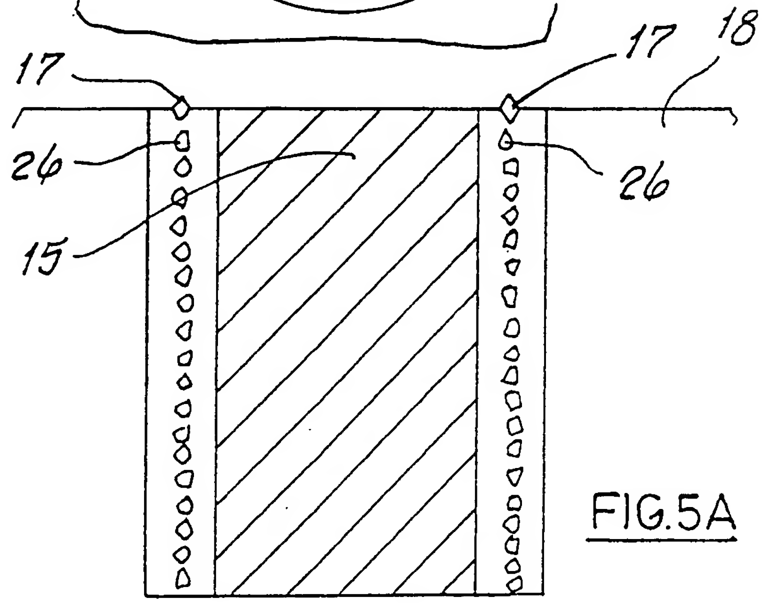

FIG.5A

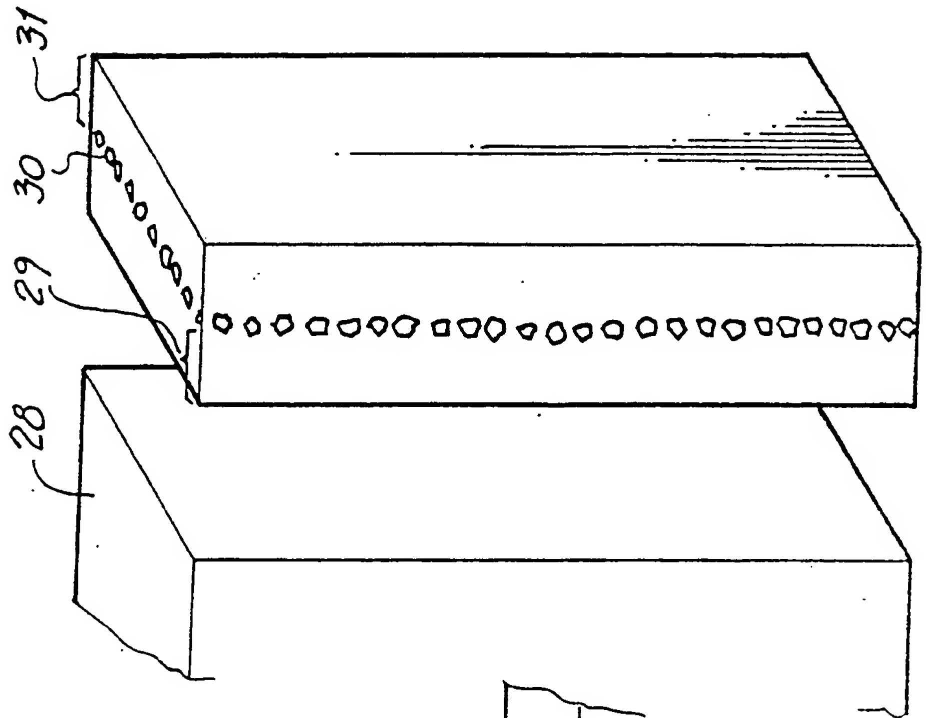

FIG.2

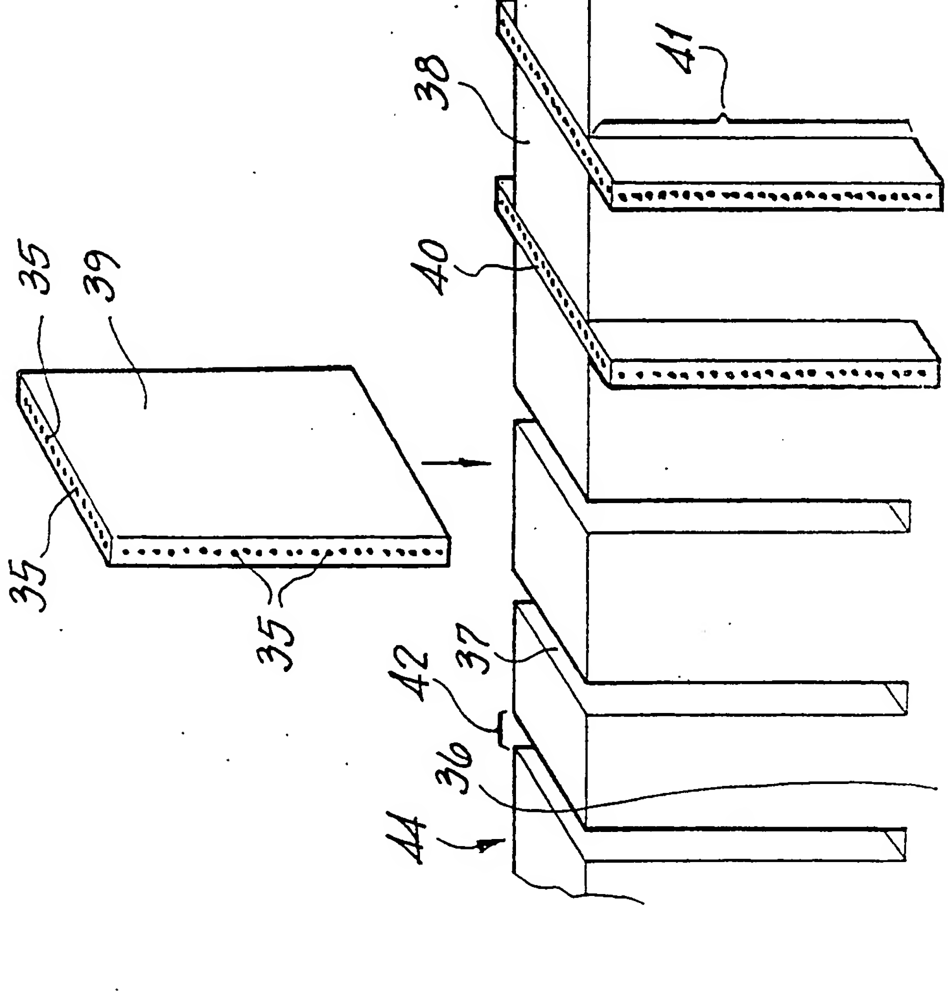

FIG.6

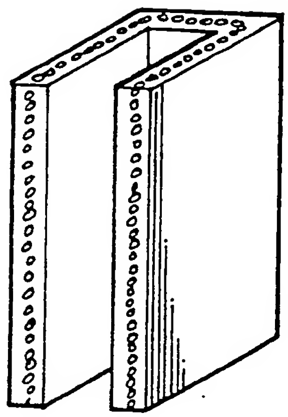

FIG.7

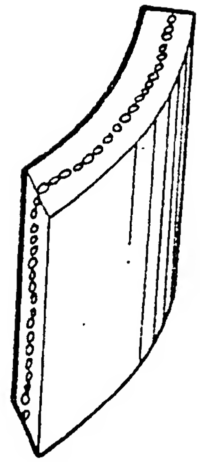

FIG.8

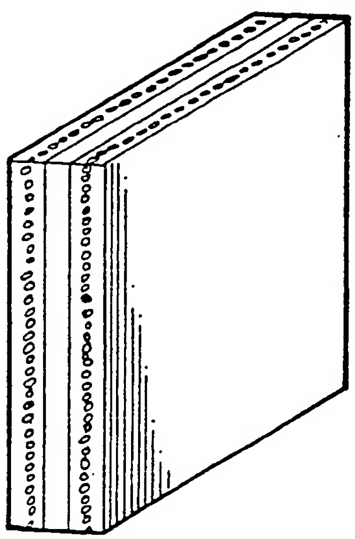

FIG.9

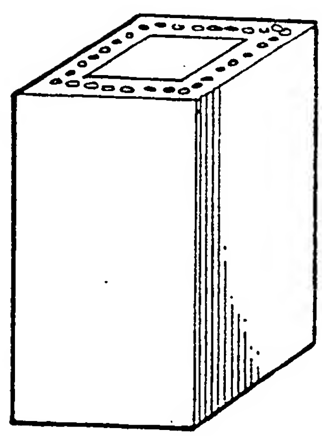

FIG.10

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 88/00714

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC^4 B 23 P 15/28, B 23 D 3/34; 18/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC^4	B 23 B; B 23 D; B 23 P; B 24 D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [*]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US,A, 3306719 (FRINGHIAN) 28 February 1967, see claim 1; col. 8, lines 5-11; figs 16 & 17 ---	1,2,16,17,20
Y	US,A, 2194546 (GODDLI ET AL) 26 March 1940, see col. 2, lines 6-36; figs 1-4 ---	1,2,16,17,20
A	DE,B2, 2127162 (SANDVIK AB) 18 July 1974, see claim 1; fig 1 ---	10
A	US,A, 3343932 (JUILLERAT) 26 September 1967, see the whole document ---	11
A	US,A, 3288580 (CURN) 29 November 1966, see claim 1; figs 3-6 --- .../...	15

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
24th November 1988	21 DEC 1988
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

Form PCT/ISA/210 (second sheet) (January 1985)

International Application No. PCT/GB 88/00714

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	EP,A2, 86086 (BOART INTERNATIONAL LTD) 17 August 1983, see page 29-32; figs 12-14 ---	15
A	US,A, 4737163 (LARKEY) 12 April 1988, see claim 1 ---	21

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/GB 88/00714
SA 24120

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 17/10/88
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3306719	28-02-67	None	
US-A- 2194546	26-03-40	None	
DE-B- 2127162	30-12-71	FR 2096507	18-02-72
		GB 1297896	29-11-72
		US 3755866	04-09-73
		AT 307196	15-03-73
		CA 943413	12-03-74
		CH 565610	29-08-75
		SE 338698	06-10-77
US-A- 3343932	26-09-67	None	
US-A- 3288580	29-11-66	None	
EP-A- 0086086	17-08-83	None	
US-A- 4737163	12-04-88	None	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82